a most important service to practical agriculture by the institution of a series of crucial experiments in its experimental grounds at Chiswick.

Dr. Hooker's statement that the starch of the diseased potatoes is not affected by the parasite, but retains its nutritive properties, is worthy of more attention than it has yet received. He recommends rasping the peeled tubers upon a grater into a tub of cold water. In a few minutes the starch will be found to have sunk to the bottom, and the diseased matter, woody fibre, &c., will be suspended in the water, and should be poured away with it. Fresh water should then be added, the starch stirred up, and again allowed to settle. Two or three of such washings will remove all impurities, and render the starch fit for use. If thoroughly dried it will keep for any time, and can be used as arrowroot for puddings and cakes, and for mixing with flour as bread. This plan is open to obvious objections, both from its tediousness, and from the fact that when the disease has made any considerable progress, the smell is so offensive as to render both the peeling and the grating alike impossible to those possessed of ordinary olfactory perception. Dr. Hooker, however, states that the plan was successfully pursued in 1845 and 1846 by the villagers of Hitcham under the direction of the late Rev. Prof. Henslow; and it seems incredible that chemical science should be unable to devise some practical and economical method for separating a wholesome substance of such enormous value in the bulk from the noxious ingredients.

Although the immediate cause of the potato disease has been clearly determined, as has been stated above, to be the attacks of a parasitic fungus, yet we are by no means prepared to agree with the conclusion of a distinguished writer,* that it "seems quite absurd, when the whole *rationale* of the potato disease has been so carefully explained, to look for an explanation in mere climatic conditions, exhaustion, weakness of constitution, or any of the empirical causes which are so often brought forward." The *Peronospora* is undoubtedly the proximate cause of the disease; for the ultimate cause we may have to look to a very different set of circumstances. It is probable that many epidemic diseases, both of men, animals, and plants, are caused by parasitic fungi; yet the attacks of the parasite may be favoured by special climatal or other conditions. We know that many animal plagues can be absolutely eradicated by the removal of the conditions which favour the propagation of the pest. The idea hinted at in our article last week that epidemic diseases may be expected in periodically recurring cycles is at least one deserving further investigation, and is supported by some curious facts. No reason has been given why the potato blight should have broken out so violently in 1845, when we had experienced before that many as ungenial summers during which it did not make its appearance, nor why it should have appeared simultaneously in so many remote countries—in St. Helena and Canada as virulently as in Europe—where the climatal conditions are altogether different; 1860 and 1872 are also not the only wet and thundery summers we have known during the last twenty years. It is quite possible that cosmical conditions may at definite intervals favour the disease, but that it may be developed only when certain other special conditions co-operate with these. We refer in another column to the systematic investigation now being carried on in France and Portugal as to the cause of the vine disease.

The period of maximum sun-spots of between eleven and twelve years, as shown by the researches of De La Rue, Stewart, and Loewy, falls in 1848, 1860, and 1872; and it is very singular that history seems to point to nearly the same approximate period for great national epidemics. Thus, according to Hecker's "Epidemics of the Middle Ages," the dates of the five great visitations of the sweating sickness in this country were 1485, 1506, 1517, 1528, and 1551, the epidemic being accompanied on almost every occasion by other pestilences in man and beast in this and other countries, or by general failure of crops. We have, of course, no means of ascertaining the condition of the surface of the sun during those years; but it is at least a singular coincidence that 29 cycles of 11·1 years bring us from 1551 to 1872.

We do not wish to lay more stress on these curious facts than they deserve, but simply to indicate the number of points of view from which the subject may be investigated. To have ascertained accurately the immediate cause of the potato disease is no doubt a great step gained; but the scientific method will not allow us to stop here. We must do our best to penetrate further into the arcana of Nature, and bring all the resources of Science to bear to investigate the conditions which appear to favour the appearance and spread of the invader, and the means which promise the greatest chance of success to repel his attacks.

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* Rev. M. J. Berkeley, in *Gardener's Chronicle*, Nov. 4, 1871.

GLADSTONE'S LIFE OF FARADAY

Michael Faraday. By J. H. Gladstone, Ph.D., F.R.S., &c. (London: Macmillan and Co., 1872.)

THERE can be no doubt that a life of Faraday suitable for the general public was much needed. Dr. Bence Jones's work, though full of interest to scientific men, and to those who knew Faraday personally, was too voluminous and too lacking in cohesion to be very widely read. Dr. Tyndall's brilliant sketch fascinated the reader with the scientific aspect of the life it recorded, but left one longing to know "the inner supplement to that noble outward life" of Faraday. Dr. Gladstone's memoir very largely meets the wants we express.

There are few men better fitted to write a life of Faraday than Dr. Gladstone. Not only was he the personal friend of Faraday, associated with him in the management of the Royal Institution, and in scientific inquiries connected with the Trinity House, but, what is more important, their pursuits and sympathies ran in nearly parallel paths. And so with a loving hand Dr. Gladstone has gathered the materials for his memoir. These are drawn only to a small extent from sources with which we are already familiar, for the author gives us the benefit of his own recollections, and also numerous incidents from the many private sources of information to which he has had access. A delightful freshness and personal interest are thus given to the narrative. Here, for example, is an anecdote that will be new to most of our readers, and which illustrates the quiet humour which Faraday possessed One evening at the Royal Institution, when a lecture on the English language was being delivered, the lecturer mentioned as a common vulgarism the habit of using "don't" in the third person singular, and cited, as an instance, "He don't pay his debts." Faraday, who was sitting in his usual place to the right of the lecturer, immediately exclaimed aloud, "That's very wrong!"

A very striking story was related to Dr. Gladstone by Cyrus Field. It is a sequel to the very circumstance that Dr. Tyndall has chosen as an example of Faraday's wonderful insight into nature, so like "a divining power." When Mr. Field was making the preliminary arrangements for that great enterprise with which his name will always be associated, he sought Faraday's advice on the electrical questions involved in a transatlantic cable. Faraday told him that he doubted the possibility of getting a message across the Atlantic. Mr. Field saw that this fatal objection must be settled at once, and begged Faraday to make the necessary experiments, offering to pay him properly for his services. The philosopher, however, declined all remuneration, but worked away at the question, and presently reported to Mr. Field—"It can be done, but you will not get an instantaneous message." "How long will it take?" was the next inquiry. "Oh! perhaps a second." "Well, that's quick enough for me," was the conclusion of the American; and the enterprise was proceeded with. This is an important incident, for not only does it show the readiness with which Faraday, when appealed to, freely lent himself to aid any scientific work, but it also indicates the confidence with which he applied the results of the laboratory to the grandest practical operations.

There are many other parts of Dr. Gladstone's memoir that we have marked for quotation, but our space will not allow us to do justice to the book by extracts. With pleasure we refer our readers to the volume itself, which is distinguished throughout by the modesty and self-forgetfulness of its author, its earnest tone, and the entire absence of all technicalities.

Dr. Gladstone will, however, permit us to indulge in a little friendly criticism on the arrangement of his materials. The memoir is divided into five parts—first, "the story of Faraday's life" is told us; then comes a "study of his character;" after which we have "the fruits of his experience," followed by "his method of working;" and in the last section we are shown "the value of his discoveries." With all deference to the reasons—no doubt well considered—which induced Dr. Gladstone to arrange his memoir thus, we venture to think that such a division is inartistic, and at first sight apt to repel a thoughtful mind. For is it not a slight upon the intelligence of his readers if an author presumes they cannot draw the study of a man's character nor "the fruits of his experience" from "the story of his life." Moreover, after having read the first part, which every one must agree is admirably done, we come upon a collection of incidents in Faraday's life, and anecdotes illustrating his character, that lose much of their force, by being massed together for a predetermined effect. It is the very spontaneousness and unobtrusiveness of the words and actions of a noble character that constitute their real claim to our admiration. And therefore we think it would have been far better if the author had woven into the life of Faraday the numerous incidents he has collected, rather than have let them lose their charm by a process of classification.

But if the arrangement is, in our humble opinion, not quite perfect, it certainly is the only blemish we can find in the work. It is a biography that will be read with interest by every intelligent person, and can be thoroughly enjoyed by those who are quite ignorant of science. It is a capital book for the youth of the present day, and among many of them we trust it will arouse a noble enthusiasm.

Now let us turn from the book to the man. Our readers do not need us to remind them of the history of Faraday, a history, which viewed in the grand achievements of his life, is so simple as to be almost sublime. Everyone knows that from a bookbinder's apprentice he lifted himself to the highest position in the scientific world. Here we may remark that we doubt whether a truly heroic nature has ever been quite covered up by the crowd of humanity. A great soul is a hero anywhere, and will win the recognition and often the worship of mankind, in spite of every obstacle. Faraday was an example of this. For the first twenty years of his life who knew him? What was his residence but a mere number in a back street? But before his death who did *not* know him? Every scientific society had laid a tribute of admiration at his feet, and he received letters inscribed to "Professor Faraday, member of all Academies of Science, London."

As his fame grew, and it became possible for him to make his name profitable, and realise thereby a considerable fortune, he permitted no selfish consideration to influence his career. Promptly rejecting that income which came from the sacrifice of his investigations, he obeyed the voice that said to him, "*Wisdom* is the principal thing, therefore get wisdom." So for fifty years one lofty idea animated his thoughts and sustained his indefatigable labour. His life became the ideas of what a philosopher's life should be, written only in the imperishable work he has done. Accepting no reward for his labours, declining any title or elevation of rank, seeking no public applause, living and dying in retirement and comparative poverty, Faraday consecrated himself to his work, and freely left to the world the magnificent revelations of a genius devoted to Nature. This surely is the life of a hero: noble devotion combined with utter unselfishness, the characteristics of a Cromwell, a Bruce, or a Garibaldi.

Though Faraday lived in retirement, and spent most of his hours in the laboratory, few men have passed a happier lifetime. No doubt the orderly and sustained simplicity of his daily life was one cause of the perpetual gladness of his heart. He confined his thoughts chiefly to his work and his home, and he regulated his life in the most methodical and natural manner. This may be seen from a little incident mentioned to the writer by Mr. Faraday's early friend, the late Mr. Benjamin Abbott. Some thirty years ago Mr. Abbott called to see Mr. Faraday, whom he had not met for many years. On inquiring at the Royal Institution the hall-porter told him that Mr. Faraday was at work, and could not be seen by anyone, indeed, that he dare not even take a visitor's card down to him. On Mr. Abbott's explaining that he was an old friend, the hall-porter suggested, with an obliging politeness which is conspicuous there still, that, as it was near one o'clock, Anderson (Faraday's faithful assistant) would soon be going to his dinner, when probably he might catch sight of Mr. Faraday coming upstairs. Mr. Abbott waited; punctually at one Anderson emerged from the laboratory, Mr. Faraday followed, and, recognising his old friend at once, begged him to join them at dinner. "For," added Faraday, "I am a Goth you know, and always dine in the middle of the day." At dinner Faraday told Mr. Abbott a characteristic story about Anderson; how one morning during his glass experiments he found his assistant had been stoking the furnace all night long. Faraday had told him to keep the fire up, and omitting to release him in the evening, Anderson, with his soldier's excellent experience, stuck to his post till he received the next orders from his master. The fact that this simple obedience was all the assistance Faraday ever had increases the astonishment with which one regards the extent of his labours. The secret of the massiveness of Faraday's work was no doubt that he felt he had *one* aim before him, and therefore he rigidly kept from himself everything that would fritter away his time; political and commercial matters were passed by; he had his warfare to accomplish, and "no man that warreth entangleth himself with the affairs of this life."

Whilst Faraday found it necessary to shut out society, he enjoyed a social gathering, especially a family of children, whom he would amuse by dexterous experiments in glass-blowing, or with other less scientific manipulation. He liked occasionally to take his nephews to the pantomime, himself enjoying, as he said, "the immense concentration of means which it requires." Or he would attend in his early days, as Dr. Gladstone tells us, "the artistic and musical conversaziones at Hullmandel's, where Stanfield, Turner, and Landseer met Garcia and Malibran; and sometimes he would join this pleasant company at supper and charades, at others in their excursions up the river in an eight-oared cutter."

His delight in giving others pleasure showed itself continually. He was considerate and courteous to the lowest servant at the Royal Institution. The writer can testify to the enduring impression made by his words of kind encouragement and acts of thoughtful friendship towards the assistants in the laboratory. As Dr. Bence Jones well remarks, his humility had a living root in his religion. Of the intense earnestness of the religious aspect of his nature, it does not become us here to speak; he did not talk, but he lived Christianity. He rose above his peculiar creed. In no sense contracted or censorious, he shed a warm radiance on all with whom he came into contact. It was impossible to dwell in his presence without feeling all that was best in one's nature rising to the surface. Most tender and touching were the words he addressed to sorrowing friends. What a depth of affection is revealed by the following letter, written to a lady who had recently lost her husband:—

> "Believe that I sympathise with you most deeply, for I enjoy in my life-partner those things which you speak of as making you feel your loss so heavily.
>
> "It is the kindly domestic affections, the worthiness, the mutual aid in sorrow, the mutual joy in happiness which has existed, which makes the rupture of such a tie as yours so heavy to bear; and yet you would not wish it otherwise, for the remembrance of those things brings solace with the grief. I speak, thinking what my own trouble would be if I lost my partner, and I try to comfort you in the only way in which I think I could be comforted."

We are reminded by this and other letters of Faraday, that the inner life of a man is best seen in the letters to his intimate friends never meant for publication. In Faraday's exquisite letters, exquisite because so utterly artless, are revealed the happy, loving spirit, and, as Mr. Ruskin would say, the "*fineness of nature*" he possessed.

Another striking characteristic of Faraday was the quiet and unostentatious manner in which he did everything. His style of lecturing was so simple and easy as to appear effortless. This apparent absence of effort is, however, the climax of self-culture. A man only does that perfectly well which he does without the evidence of exertion. Faraday had reached this point through the mental discipline to which he habitually subjected himself. He translated into practice the words in which he expresses his own "strong belief that that point of self-education which consists in teaching the mind to resist its desires and inclinations until they are proved to be right, is the most important of all, not only in affairs of natural philosophy, but in every department of life."

With all this stern reality there was also a fine poetic fancy in Faraday. To him the Universe was no machine. His was "a face-to-face, heart-to-heart, inspection of things," and this, as Carlyle says, is "the first characteristic of all good thought in all times." Scientific phraseology never hid from him the grandeur and mystery that at bottom lies in everything. A thunder-storm was to him no mere affair of positive and negative electricity, no mere discharge of electric potential, but something infinitely beyond all this—"a window through which he looked into Infinitude itself." Dr. Gladstone tells us "he would stand gazing at the lightning, a stranger to fear, with his mind full of lofty thoughts, or perhaps of high communings. Sometimes, too, if the storm were at a little distance, he would summon a cab, and in spite of the pelting rain, drive to the scene of awful beauty." A friend thus met him once at Eastbourne, "in the thick of a tremendous storm, rubbing his hands with delight because he had been fortunate enough to see the lightning strike the church tower."

We are told that a new fact "seemed to charge him with an energy that gleamed through his eyes and quivered through his limbs." The writer remembers an illustration of this, when Dr. Tyndall brought Mr. Faraday into the laboratory to look at his new discovery of calorescence. As Faraday saw for the first time a piece of cold, black platinum raised to a dazzling brightness when held in the focus of dark rays, a point undistinguishable from the air around, he looked on attentively, putting on his spectacles to observe more carefully, then ascertained the conditions of the experiment, and repeated it for himself; and now quite satisfied he turned with emotion to Dr. Tyndall and almost hugged him with pleasure. And so on another occasion, when Prof. Plücker was showing in the laboratory some lovely experiments with vacuum tubes, Faraday literally danced with delight round the electric discharge, exclaiming, as he gazed at the moving arches of light, "Oh! to live always in it!"

We have said enough. Our readers will forgive us for recalling a character which many of them know far better than the writer. But we are never tired of contemplating a nature so singularly beautiful as that of Faraday. Whether we think of him as pourtrayed by Dr. Bence Jones, Dr. Tyndall, or Dr. Gladstone, or by Prof. Helmholtz, Dumas, or De la Rive, the picture is still the same;—

> "His life was gentle; and the elements
> So mix'd in him, that Nature might stand up
> And say to all the world, 'This was a Man!'"

W. F. BARRETT

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

American Stone Arrowheads

I AM glad to perceive that Dr. Abbott has called attention to the variations in form among North American stone arrowheads, although he cannot admit the correctness of some of the remarks I have incidentally made on this subject in my "Ancient Stone Implements of Great Britain." At the time when that work went to press, I was not in possession of Dr. Abbott's "Stone Age in New Jersey," if, indeed, it had appeared, and in describing the various North American forms, for want of other authorities I principally referred to Schoolcraft, Squier and Davis, and Prof. Daniel Wilson, some of whom Dr. Abbott appears to consider as somewhat antiquated.

It is not to be supposed that my acquaintance with the collections in the United States should in any way approach that of Dr. Abbott, as I have never visited America. My views as to the prevalence of different types were, however, mainly founded, not on printed descriptions, but on actual specimens preserved in collections in this country, my own among the number; and with all deference to Dr. Abbott, who has kindly promised to send me the specimens on which he bases his remarks, I think it will be found that his views, even if completely applicable to New Jersey, will hardly hold good throughout the northern part of the United States and Canada. The principal points on which he disagrees with me are—

1. As to the arrowheads with a notch at the base on either side constituting a prevailing type in North America.
2. As to the leaf-shaped form being very rare.
3. As to the chipping being for the most part but rough, as compared with that exhibited on the arrowheads found in Britain.

1. As to the first point, Dr. Abbott does not appear to appreciate the difference between "a" and "the;" and though it is possible that other forms of arrowheads are found in America in equal numbers with those such as I have mentioned, yet I think he would agree with me, if he were comparing a series, from North America with one from some other country, in recognising those with a notch at the base on either side as offering one of the prevailing types.

2. As to the leaf-shaped form being very rare, I may observe that among the thirty-eight figures of arrowheads given by Dr. Abbott in his "Stone Age in New Jersey" only one is leaf-shaped, though he mentions the plain leaf-shaped form as the prevailing variety of the leaf-shaped arrowhead and its modifications. In my own collection, comprising upwards of 160 North American arrowheads, there are only six that can be termed leaf-shaped, and but two of these are really typical specimens of the form. These two have come into my possession since my book was written. If not "very rare" I think the form must be regarded as comparatively rare.

3. Lastly, as regards workmanship, Dr. Abbott seems not to have observed that my statement as to the roughness of chipping was qualified with the words "for the most part." Anyone comparing a collection of stone arrowheads from North America with one formed in Britain or Ireland would, I think, at once admit that, as a whole, the latter were more finely and delicately chipped. Or, again, comparing Dr. Abbott's illustrations with mine the same general conclusion will be attained. Even the most elegantly formed American specimens that I have seen cannot compete in delicacy of workmanship with some of the English examples, such, for instance, as those represented in my Figures 317, 318, 319. I can only say that if Dr. Abbott or any other American collector will kindly send me some specimens equally well-chipped, I shall be proud to add them to my collection, and not too proud to acknowledge any errors into which I may have been betrayed through insufficiency of knowledge.

JOHN EVANS

Nash Mills, Hemel Hempsted, Sept. 14

Botanical Terminology

BOTANY is now being taught to large numbers in public and middle-class schools; its admission as a subject of general study can only be justified by its high educational value, not so much as an end, but as a means. Many of the boys who work at it will have no time to continue the study in detail, and the little they know of it will be what they learn at school.

Upon all these grounds it is desirable that there should be no unnecessary or conventional impediments placed in the way of as much education as possible being given in the short time allotted to it. I am desirous of eliciting an opinion as to whether the botanical terminology is or is not an impediment, diminishing the educational value and restricting the scope of the subject. For some years at Rugby I have felt myself hampered with a weariness of names. Is a terminology as polyglot in its derivation as the tower of Babel, and often involving questionable hypotheses of function, or incorrect ideas of morphology, the best instrument for making young pupils observe accurately or reason accurately on observed results? And yet a teacher cannot select the terms he will use, (1) because the books, and especially the English and local floras, imply in their readers a knowledge of a wide terminology; and (2) because, as in the fight against Euclid, so here, the teacher is subject to the examiner, and at present the examination papers of the Science and Art Department, Cambridge Local, &c., are incomprehensible to a boy not bristling with terms.

Allow me specially to call attention to some of what appear to me unnecessary faults in the terms used, and to suggest one or two remedies. The names chosen to denote parts are mainly derived from Latin or Greek, or both, or have no received derivation. Well, even supposing that the words do, by their derivation from the dead language, suggest to those who know it some clue to their meaning, yet how few boys can keep these derivations in their heads, especially in schools in which Latin is not much and Greek not at all taught. Why on earth, when the promoters of science are driving out Greek to let in science, should a knowledge of Greek be a necessary "open sesame" to the correct remembering and spelling of botanical terms?

But the above supposition is seldom correct, the words when translated expressing either a fanciful resemblance, or some pre-adamite stage of botanical knowledge. If the opening through which the pollen-tube passes is already called "little gate," perhaps we must submit to the name, but why call it "micropyle."?

And here perhaps is the place to make a protest against such words as were flooded into the science at the time when the sexuality of plants was first established.

The usefulness of insisting on the generalisation that gamogenesis was common to plants and animals only exists in teaching those who know what gamogenesis in animals means. Does that usefulness exist in the case of boys and girls who learn botany.? In teaching Human Physiology, some subjects are omitted and rightly omitted, from such text-books as Huxley's Elementary Physiology; why then should a knowledge of such subjects be assumed in our botanical terms? The facts of botany can all be taught, as far as my experience of boys and girls goes, without the slightest difficulty; the generalisation will follow of itself, as soon as it is wanted; I only object to its being gratuitously, and almost pruriently, forced on the attention. Who can approve of the use in our elementary floras of the term "hermaphrodite," or the same symbols for pistillate and staminate plants being used which the boys are taught in their astronomy as the recognised symbols for Venus and Mars? To this class belong the tribe of words ending in *—androus* and *—gynous*, which must either be taught as unintelligible gibberish, or explained on gamogenetic analogy. I do not wish to be misunderstood: if you are teaching the physiological subjects in animals, let "honi soit" be your motto, and call a spade a spade; there are worse evils than we dream of arising from obscurantism; but if you are teaching botany, keep to your subject, and do not go out of your way to call a club a spade.

Lastly, many words are utterly confusing: either they seem by their jingling similarity to make the learner and indeed even